

MINIATURE CIRCULATOR DEVICES AND METHODS FOR MAKING THE SAME

ABSTRACT OF THE DISCLOSURE

Miniature optical devices, including circulator array devices, are fabricated using thin film coating technology. A typical optical device according to the present invention includes two refraction elements arranged opposite each other along a propagation axis and coupled on opposite ends to first and second polarization orientation elements with first and second polarization beam splitter (PBS) elements are coupled to the first and second polarization orientation elements, respectively. The refraction elements include complementary Wollaston Prism elements or complementary Rochon Prism elements. Each polarization orientation element includes a Faraday rotator element, and in some embodiments, each also includes a half-wave plate formed using thin film coating techniques. The Faraday rotator elements are periodically poled in some embodiments using selective poling techniques to create oppositely oriented (bi-directional) magnetic domains so that polarization rotations of 45° in both clockwise and counter-clockwise directions can be simultaneously achieved on the same magnetic garnet. Periodically etched half-wave plates are used in some embodiments. Depending on the orientation of the refraction elements and the optical axes of the first and second PBS elements, the constituents of each polarization orientation element are designed and oriented so that the circulator device achieves a circulating operation with optical signals at an input port, i , coupled to one PBS element being passed to an output port, $i+1$, coupled to the other PBS element in a non-reciprocal manner.